



ENGINEERS  
SURVEYORS  
PLANNERS

Mr. Gustavo Gomez  
City of Santa Clara  
Engineering Department  
1500 Warburton Avenue  
Santa Clara, CA 95050

July 20, 2015

**Subject: Building G Sewer Study  
3333 Scott Campus Development (3535 Garrett Drive)**

Dear Mr. Gomez,

This report will analyze the sanitary sewer flows for the proposed development at the project site located at 3535 Garrett Drive. The proposed site consists of an 8-story office building (Building G) and a parking structure (Parking Structure P2). The existing 118,800 square foot building structure that is currently on the 3535 Garrett site is an occupied building. It will be demolished and replaced with the new Building G. Building G accounts for 247,769 square feet of office space. Parking Structure P2 will not contribute to the sanitary sewer flows for the site. For the purpose of this sanitary sewer study, the square footage of the existing occupied building will be credited to (subtracted from) the proposed Building G's office space square footage.

Proposed Building G Area	Existing (Occupied) 3535 Garrett Drive Building Area	Total Area to be Analyzed
247,769 sq. ft.	118,800 sq. ft.	128,969 sq. ft.

The Building G square footage that will be contributing additional sewer flow to the Tannery Way sanitary sewer system will be 128,969 square feet.

Please refer to Exhibit "B" for the Scott Campus Site Plan detailing the existing and proposed building square footage.

The Sanitary Sewer Report by V&A dated September 2011 documents the sanitary sewer flow at Tannery Way, upstream of Sanitary Sewer Manhole 13 as shown on the Sanitary Sewer Exhibit "A". This report includes sanitary sewer flows from existing buildings along Scott Boulevard, Garrett Drive (including 3535 Garrett Drive), and Tannery Way that fall within the tributary area for Sanitary Sewer Manhole 13.

**Sanitary Sewer Calculation Sheet for Site 1 (See exhibit for Location)**

Block Maps S72 and S73 provided by the City of Santa Clara (see attached) show the Tributary Area served by the sanitary sewer main that was monitored by V&A. The total project Tributary Area is approximately 64.22 acres. The City of Santa Clara Sanitary Sewer Capacity Assessment Figure 3-3 shows the flow meter areas used for infiltration and inflow analysis. Approximately 10.10 acres (15.7%) of the Tributary Area falls within meter area M\_07. Of that area, 4.74 acres are part of the project site and 5.36 acres are from the Tributary Area surrounding the site. The remainder of the Tributary Area,

1650 Technology Drive  
Suite 650  
San Jose  
California 95110  
phone 408.467.9100  
fax 408.467.9199  
www.bkf.com

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Gustavo Gomez

54.12 acres (84.3%), falls within meter area M\_08. The breakdown of the tributary areas is shown in Exhibit "A".

The formula below was used to calculate the flow contributing to the Garrett/Tannery System:

$$Q_D = Q_M + Q_{WWGI} + Q_{RDI/I} + Q_{PD}$$

### **Monitored Flow**

$Q_M =$  The greater of:  
Monitored Peak Flow **-Or-**  $2.5 \times (\text{Monitored Average Flow})$

From V&A Sanitary Sewer Report, dated September 2011 (attached):

Monitored Peak Flow = 14.0 gpm

Monitored Average Flow = 5.8 gpm

$2.5 \times (\text{Monitored Average Flow}) = 2.5 \times 5.8 \text{ gpm} = 14.5 \text{ gpm} > 14.0 \text{ gpm}$

$Q_M = \underline{\underline{14.5 \text{ gpm}}}$

### **Wet Weather Groundwater Infiltration**

Per the City of Santa Clara Sanitary Sewer Capacity Assessment Table 3-2 GWI and RDI/I Parameters by Meter Area (attached), the Wet Weather GWI factor for meter area M\_07 is 1,900 gpd/acre, and for meter area M\_08, the factor is zero. The calculation for the weighted Wet Weather GWI rate is shown below.

$Q_{WWGI} = 1,900 \text{ gpd/Acre}$

Tributary Area (TA) for Meter Area M\_07 with the 12" SS:

3385 Scott Boulevard: 2.03 Acres

3375 Scott Boulevard: 2.52 Acres

Garrett Drive R/W Area: 0.36 Acres (Portion of Garrett Drive roadway TA that is within M\_07)

APN 216-31-060: 0.45 Acres (Portion of TA within M\_07)

APN 216-31-080: 4.74 Acres (Portion of Project Site within M\_07)

**Total M\_07 Tributary Area = 10.10 Acres**

(See Sanitary Sewer Exhibit "A" for Tributary Areas)

$Q_{WWGI} = (1,900 \text{ gpd/Acre}) \times (10.10 \text{ Acres})$   
 $= \underline{\underline{19,190 \text{ gpd or } 13.33 \text{ gpm}}}$

### **Rainfall-Dependent Infiltration and Inflow**

Per the City of Santa Clara Sanitary Sewer Flow Monitoring Design Flow Determination worksheet, the Rainfall-Dependent Infiltration and Inflow factor for both meter areas M\_07 and M\_08 is 1,000 gpd/acre. The calculation for the Rainfall-Dependent Infiltration and Inflow rate is shown below.

$$Q_{RDI/I} = (1,000 \text{ gpd/Acre}) \times (64.22 \text{ Acres}) = \mathbf{64,220 \text{ gpd or } 44.60 \text{ gpm}}$$

### **Proposed Development Peak Flow**

The City of Santa Clara Sanitary Sewer Capacity Assessment Table 2-5, Base Wastewater Flow Unit Flow Factors for Office/R&D Type Development shows:

$$\begin{aligned}\text{Unit Flow Factor} &= 0.15 \text{ gpd/Sq. Ft.} \\ \text{Peaking Factor} &= 2.5\end{aligned}$$

#### **Vacant Building Areas on Adjacent Lots**

APN 216-31-062	= 39,182 Sq. Ft.
APN 216-31-070	= 36,895 Sq. Ft.
APN 216-31-069	= 43,756 Sq. Ft.
APN 216-31-068	= 82,633 Sq. Ft.
APN 216-30-048	= 52,011 Sq. Ft.
<u>APN 216-30-049</u>	<u>= 72,435 Sq. Ft.</u>
Total Area:	= 326,912 Sq. Ft.

#### **Proposed Development:**

Building G	247,769 Sq. Ft	→ Discharges to Tannery Way
<u>Existing 3535 Garrett Bldg</u>	<u>-118,800 Sq. Ft.</u>	<u>→ Included in V&amp;A Flow Analysis</u>
Total Net Area:	<b>128,969 Sq. Ft.</b>	<b>(To be analyzed in this report.)</b>

$$\begin{aligned}Q_{PD} &= 2.5 \times [(\text{Unit Flow Factor}) \times (\text{Total Net Area Square Footage}) + \\ &\quad (\text{Unit Flow Factor}) \times (\text{Total Vacant Building Areas Square Footage})] \\ Q_{PD} &= 2.5 \times [(0.15 \text{ gpd/Sq. Ft.}) \times (128,969 \text{ Sq. Ft.}) + \\ &\quad (0.15 \text{ gpd/Sq. Ft.}) \times (326,912 \text{ Sq. Ft.})] \\ &= 2.5 \times [19,346 \text{ gpd} + 49,037 \text{ gpd}] = 170,956 \text{ gpd} \\ &= \mathbf{118.72 \text{ gpm}}\end{aligned}$$

$$Q_D = Q_M + Q_{WWGI} + Q_{RDI/I} + Q_{PD}$$

$$Q_D = 14.5 \text{ gpm} + 13.33 \text{ gpm} + 44.60 \text{ gpm} + 118.72 \text{ gpm}$$

$$Q_D = \mathbf{191.15 \text{ gpm} = 0.43 \text{ CFS}}$$

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Pipe Capacity of the 12" Sanitary Sewer at 0.246% <sup>(1)</sup> = **1.78 CFS = 799 gpm**

From Manning's Equation (See attached Sanitary Sewer Calculations for Site 1):

Depth of Flow of 12" SS at 0.246% <sup>(1)</sup> = 0.33 ft

**Depth of Flow/Pipe diameter = (0.33 ft/1 ft) = 0.33 < 0.75**

**Pipe is adequate for  
proposed development**

<sup>(1)</sup> Slope of sanitary sewer pipe per survey

Please contact me if you have any questions or require any additional information.

Sincerely,



Nellie Moussa, P.E.  
Project Engineer



## Sanitary Sewer Calculations for Site 1

Project Name: Building G – 3535 Garrett Drive (3333 Scott Site)

BKF Project No: 19976093

Date: 07/20/2015

### Manning Pipe Calculator

#### Given Input Data:

Shape ..... Circular  
Solving for ..... Depth of Flow  
Diameter ..... 1.0000 ft  
Flowrate ..... 0.4259 cfs ←  $Q_D$   
Slope ..... 0.0025 ft/ft  
Manning's n ..... 0.0130

#### Computed Results:

Depth ..... 0.3329 ft ← Depth of Flow  
Area ..... 0.7854 ft<sup>2</sup>  
Wetted Area ..... 0.2287 ft<sup>2</sup>  
Wetted Perimeter ..... 1.2300 ft  
Perimeter ..... 3.1416 ft  
Velocity ..... 1.8621 fps  
Hydraulic Radius ..... 0.1860 ft  
Percent Full ..... 33.2858 %  
Full flow Flowrate ..... 1.7814 cfs  
Full flow velocity ..... 2.2682 fps

1650 TECHNOLOGY DRIVE  
SUITE 650  
SAN JOSE, CA 95110  
408-467-9100 (TEL)  
408-467-9199 (FAX)

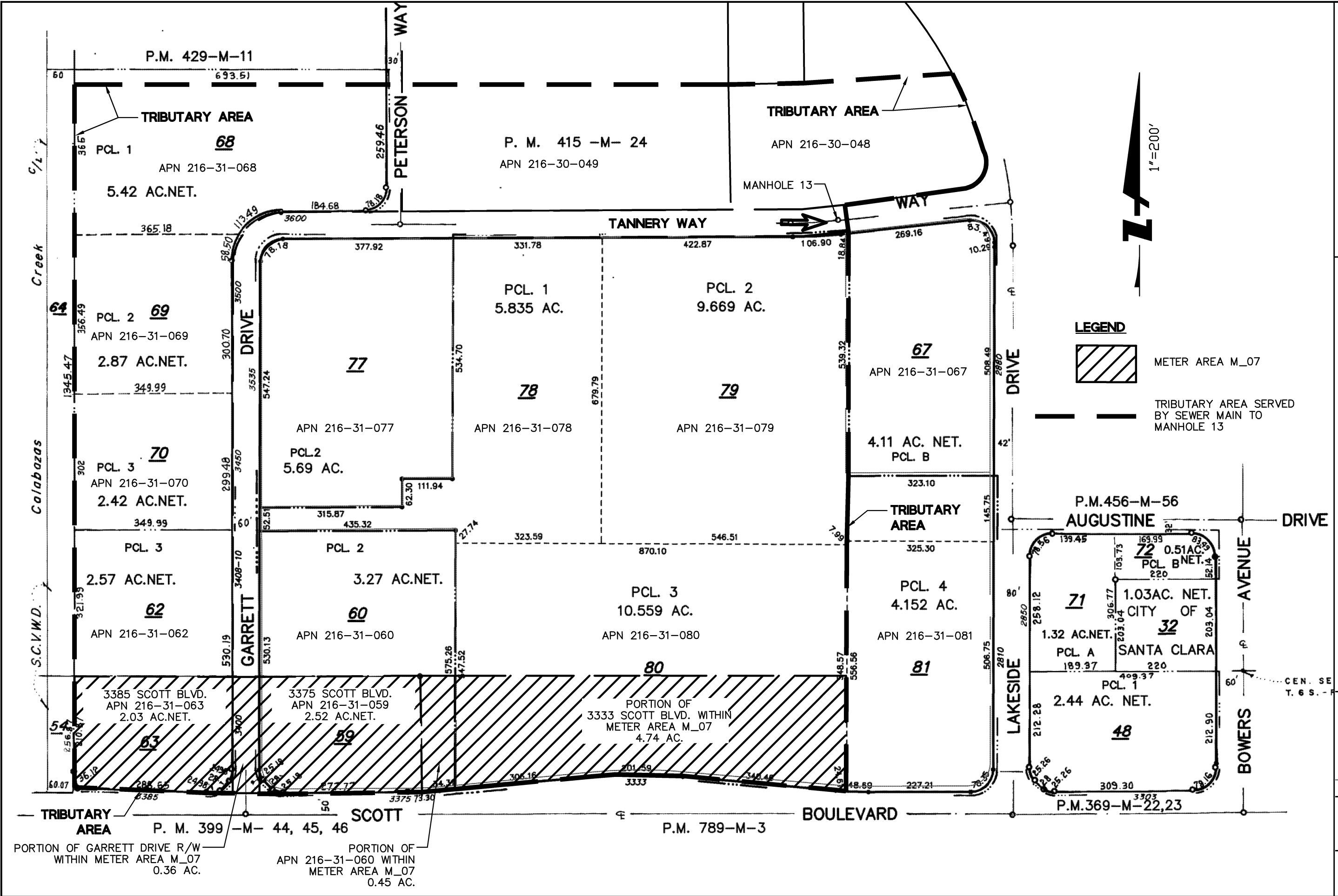


CALIFORNIA

**3333 SCOTT BOULEVARD  
SANITARY SEWER EXHIBIT "A"**

SANTA CLARA

Revisions	No.	Date	By	Appr.
Drawing Number:				
<b>EXH A</b>				
1 OF 1				



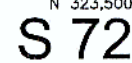
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PLOT TIME: 09-30-11  
PLOT BY: hna

PORTION OF GARRETT DRIVE R/W  
WITHIN METER AREA M\_07  
0.36 AC.

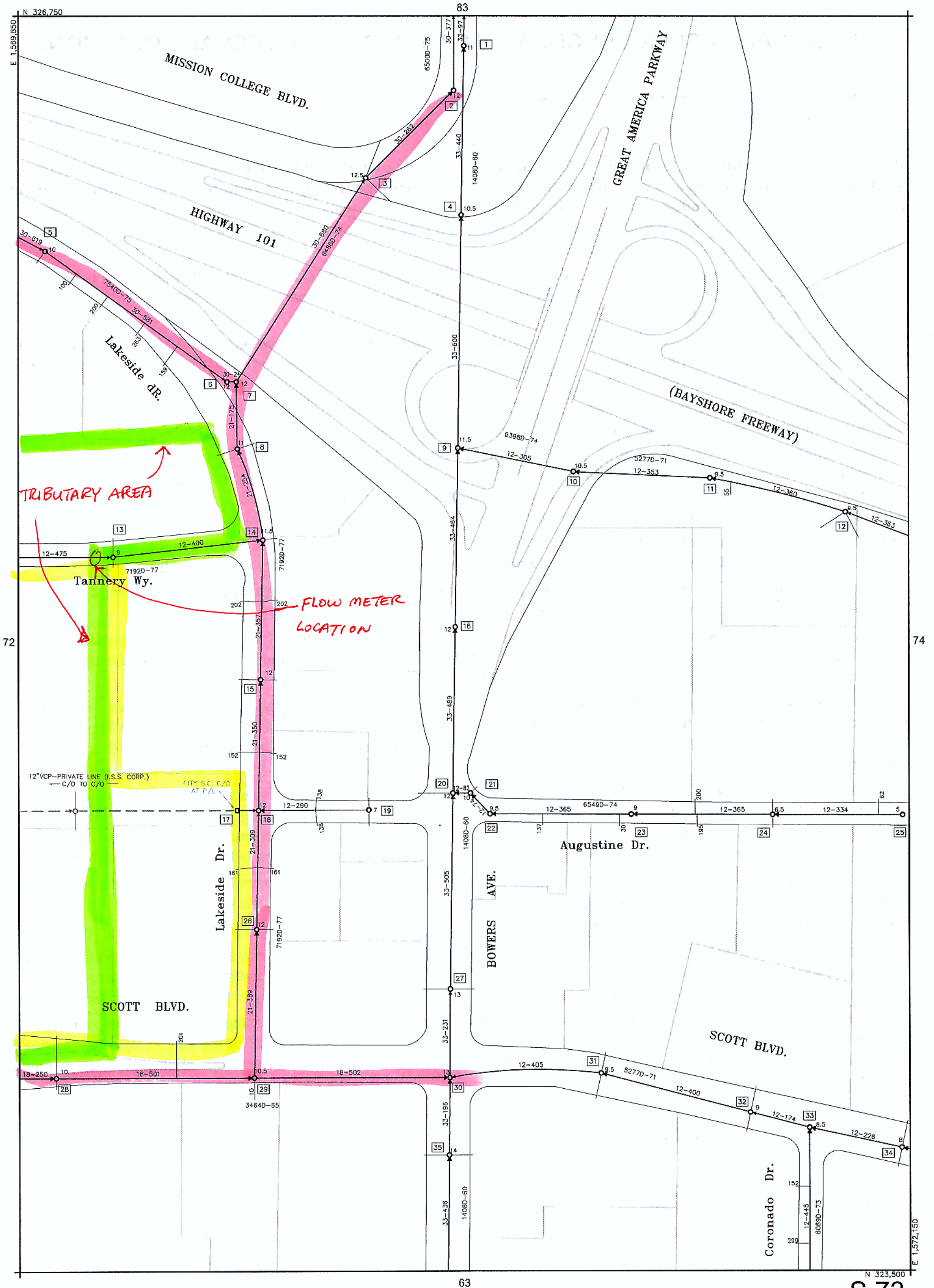
PORTION OF  
3333 SCOTT BLVD. WITHIN  
METER AREA M\_07  
0.45 AC.











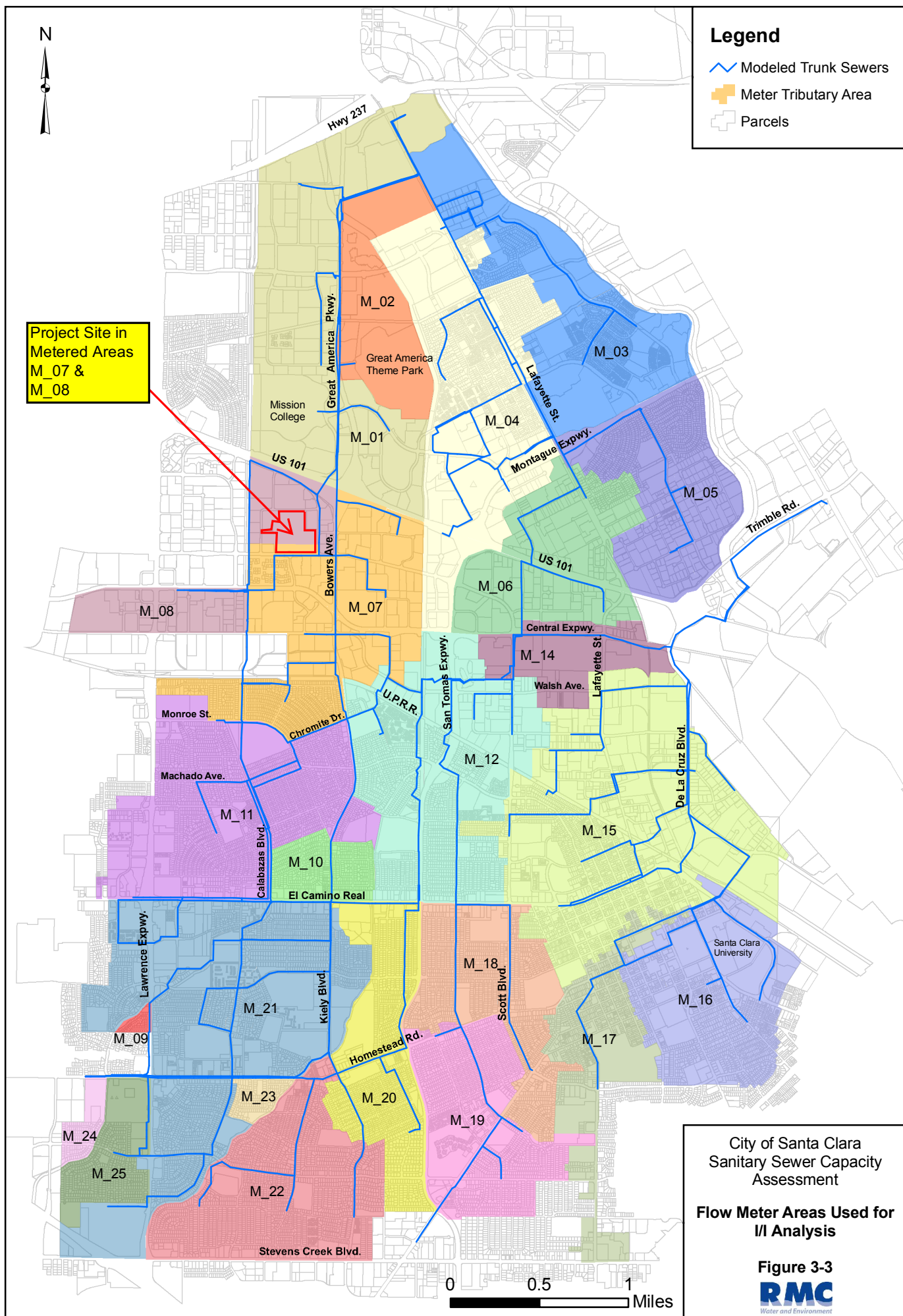


Table 3-2 GWI and RDI/I Parameters by Meter Area

Meter Area <sup>a</sup>	Dry Weather GWI <sup>b</sup> (gpd/acre)	Wet Weather GWI <sup>c</sup> (gpd/acre)	R1 RDI/I Vol. (%) (2 hrs. to peak)	R2 RDI/I Vol. (%) (6 hrs. to peak)	R3 RDI/I Vol. (%) (12 hrs. to peak)
M_01	0	0	0.5	0.8	0.8
M_02	0	0	0.5	0.8	0.8
M_03	0	0	0.6	0.1	0.1
M_04	500	1,300	0.6	0.1	0.1
M_05	700	1,000	0.6	0.1	0.1
M_06	0	0	0.6	0.1	0.1
M_07	1,900	1,900	0.3	0.5	0.5
M_08	0	0	0.3	0.5	0.5
M_09	0	0	0.6	0.1	0.1
M_10	0	0	0.6	0.1	0.1
M_11	1,600	2,300	0.9	1.7	6.0
M_12	0	0	0.9	1.0	0.5
M_14	0	0	0.6	0.1	0.1
M_15	300	700	1.0	0.2	0.2
M_16	900	1,600	1.0	0.2	0.2
M_17	200	200	0.6	0.1	0.1
M_18	0	0	0.8	1.0	0.1
M_19	0	0	0.3	0.1	0.1
M_20	0	0	0.6	0.1	0.1
M_21	0	0	0.6	0.1	0.1
M_22	0	0	0.6	0.1	0.1
M_23	0	0	0.6	0.1	0.1
M_24	0	0	0.6	0.1	0.1
M_25	0	0	0.6	0.1	0.1
CuSD	0	0	0.5	0.2	0.4

(a) See Figure 3-3.

(b) Represents GWI during non-rainfall periods (e.g., early to mid-February) of the 2006 flow monitoring period.

(c) Represents GWI immediately following rainfall events.

Table 2-5 Base Wastewater Flow Unit Flow Factors

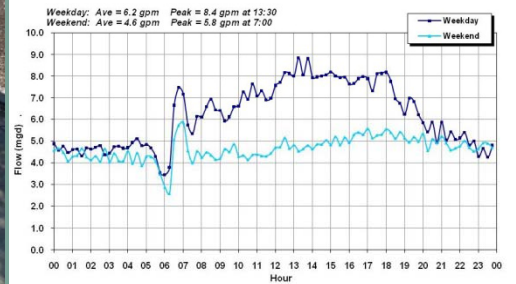
Type of Development	Unit Flow Factor	Basis
Single Family Detached	245 gpd/DU	3.5 people/DU @ 70 gpcd
Townhouses/Condominiums	175 gpd/DU	2.5 people/DU @ 70 gpcd
Apartments	154 gpd/DU	2.2 people/DU @ 70 gpcd
Hotels	100 gpd/room	
Commercial/Office	0.1 gpd/sq. ft.	
Office/R&D	0.15 gpd/sq. ft.	
Moderate Density Residential (Mixed Use)	3,200 gpd/acre	21 DU/acre @ 154 gpd/DU
Medium Density Residential (Transit-Oriented Mixed Use)	4,600 gpd/acre	30 DU/acre @ 154 gpd/DU
Commercial/Office/R&D Intensification <sup>a</sup>	+ 300 gpd/acre	+ 0.04 FAR @ 0.15 gpd/sq. ft.

(a) Applied to areas of North Santa Clara where existing development is anticipated to increase in intensity from a current average floor-area-ratio (FAR) of 0.41 to a future average of 0.45.

### 2.3.3 Diurnal Base Wastewater Flow Patterns

In most sewer systems, BWF exhibits typical diurnal patterns depending on the type of land use. For Santa Clara, typical diurnal curves were developed for residential, commercial, and industrial areas, for both weekend and weekday conditions. These curves are shown in **Figure 2-4**. Each area of the system was assigned a diurnal curve according to its predominant land use type.





# SANITARY SEWER FLOW MONITORING AND CAPACITY ANALYSIS

City of Santa Clara

September 2011



# **SANITARY SEWER FLOW MONITORING AND CAPACITY ANALYSIS**

City of Santa Clara

Prepared for:  
Menlo Equities  
490 California Street, 4<sup>th</sup> Floor  
Palo Alto, CA 94306

Prepared by



September 2011

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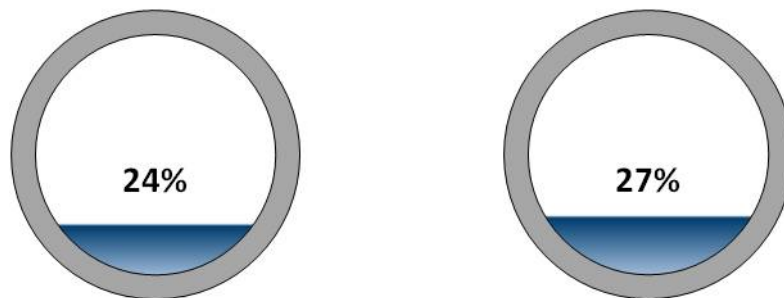
## EXECUTIVE SUMMARY

V&A has completed a sanitary sewer flow monitoring and capacity study within the City of Santa Clara, CA. One 12-inch segment on Tannery Way (Figure 2) was monitored for a one-week period from August 25, 2011 to September 6, 2011. The purpose of this study was to capture existing baseline flows at the flow monitoring location. The results of flow monitoring are summarized in Table 1. Figure 1 shows graphical snapshots of average and peak measure flows. The flow monitoring data suggests that there is a pump station upstream from the flow monitoring site. Given a typical pump station's run time and the flow monitoring data reporting interval of 15 minutes, the instantaneous peak flows discharging the pump station may not have been captured at through the flow monitoring site due to attenuation.

**Table 1. Summary of Flow Monitoring Data**

Item	Result
Site 1 – Estimated 100% Capacity of Pipeline:	796 gpm
Site 1 – Average Dry Weather Flow:	5.8 gpm
Site 1 – Peak Measured Dry Weather Flow:	14.0 gpm
Site 1 – Available Capacity (Capacity less Peak):	782 gpm

*gpm = gallons per minute*

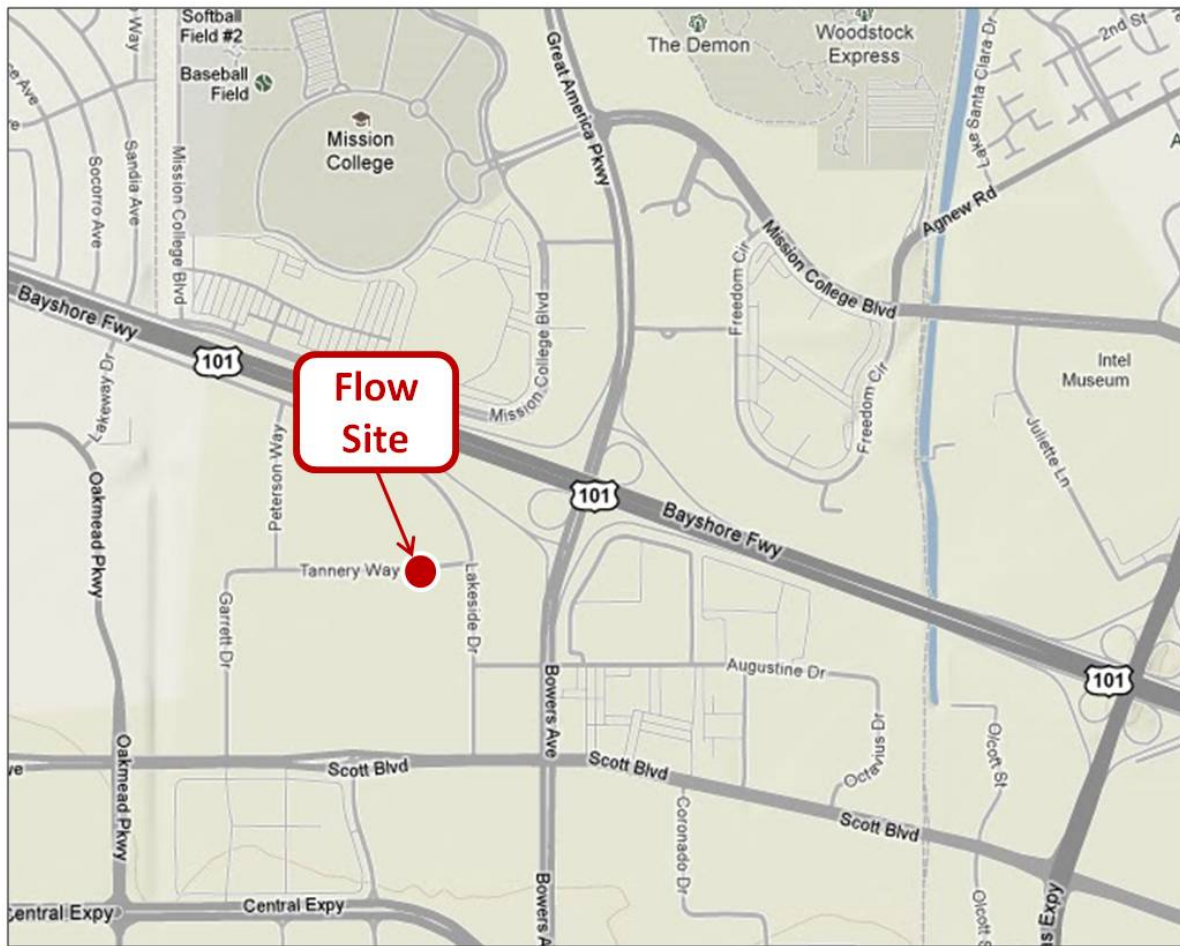


**Figure 1. Average and Peak Flow Cross-Sectional Snapshot Views**

## INTRODUCTION

V&A has completed sanitary sewer flow monitoring for Menlo Equities. Flow monitoring occurred over a one-week period from August 25 to September 6, 2011, at one open-channel flow monitoring site located on Tannery Way in the City of Santa Clara (City), California. The purpose of this study was to capture existing baseline flows at the flow monitoring location.

Figure 2 shows the overview of the flow monitoring location. Photo 1 shows a surface view and Photo 2 shows a plan view of the flow monitoring site. Figure 3 shows the location of the site on a sanitary sewer map and Figure 4 is a flow sketch of the site.



**Figure 2. Overview of Flow Monitoring Location**



Photo 1. Street View of Flow Monitoring Site



Photo 2. Plan View of Flow Monitoring Site



Figure 3. Sanitary Map

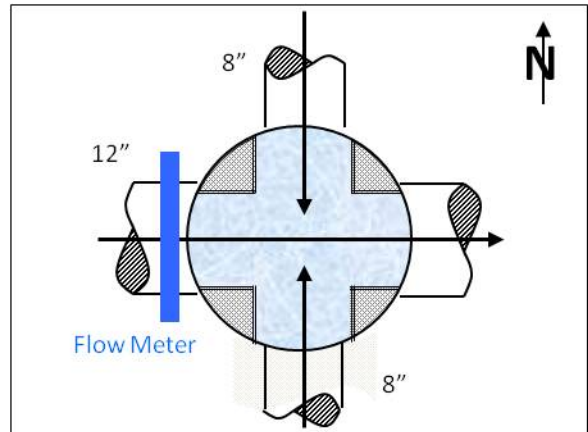


Figure 4. Flow Sketch

## METHODS AND PROCEDURES

### Confined Space Entry

A confined space is defined as any space that is large enough and so configured that a person can bodily enter and perform assigned work, has limited or restricted means for entry or exit and is not designed for continuous employee occupancy. The atmosphere must be constantly monitored for sufficient levels of oxygen (19.5 to 23.0%) and the absence of hydrogen sulfide ( $H_2S$ ) gas, carbon monoxide (CO) gas and LEL (lower explosive limit) levels. A typical confined space entry crew has members with OSHA-defined responsibilities of Entrant, Attendant and Supervisor (Photo 3). The Entrant is the individual performing the work. He or she is equipped with the necessary personal protective equipment needed to perform the job safely, including a personal 4-gas monitor (Photo 4). If it is not possible to maintain line-of-sight with the Entrant, then more Entrants are required until line-of-sight can be maintained. The Attendant is responsible for maintaining contact with the Entrant(s) to monitor the atmosphere on another 4-gas monitor and maintaining records of all Entrants, if there is more than one. The Supervisor develops the safe work plan for the job at hand prior to entering.



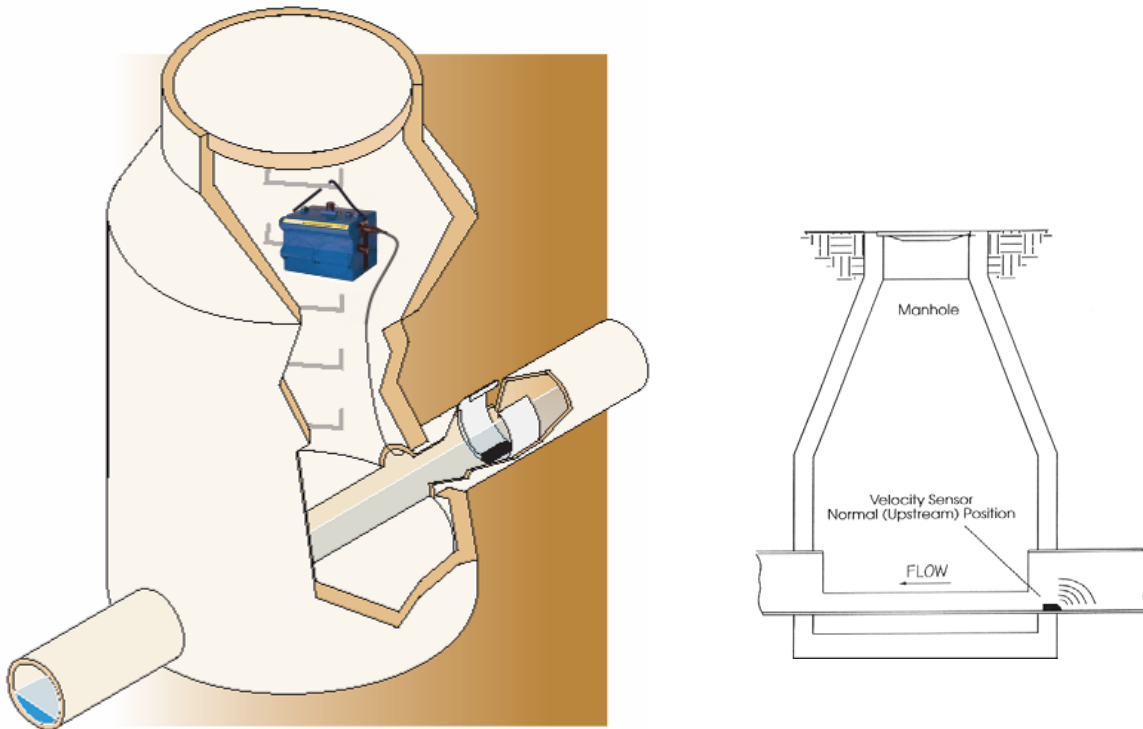
**Photo 3. Confined Space Entry**



**Photo 4. Typical Personal 4-Gas Monitor**

## Flow Meter Installation

One Isco 2150 flow meter was installed by V&A. Isco 2150 meters use a pressure transducer to collect depth readings and ultrasonic Doppler sensors on the probe to determine the average fluid velocity. Figure 5 shows a sketch of a typical flow meter installation.



**Figure 5. Typical Flow Meter Installation**

Continuous depth and velocity readings were recorded by the flow meter in 5-minute increments and downloaded into a computer spreadsheet program where the data could be analyzed and made report ready. Manual level and velocity measurements were taken in the field during flow meter installation and again when the flow meter was removed. These manual measurements were compared to simultaneous level and velocity readings from the flow meter to ensure proper calibration and accuracy. The pipe diameter was also verified in order to use the correct geometry in calculating flows.



## FLOW MONITORING RESULTS

Table 2 summarizes the flow monitoring data recorded during this study. Figure 6 and Figure 7 on the following pages graphically illustrate the flow monitoring data recorded during this study. Figure 8 illustrates a snapshot of the pipe full (d/D) condition during average and peak dry weather flow conditions. Note that:

- ❖ ADWF = Average Dry Weather Flow,
- ❖ Peak = Peak flow as measured during the entire flow monitoring period,
- ❖ Peaking Factor = Peak Measured Flow / ADWF,
- ❖ d/D Ratio = Peak measured depth / Pipe diameter. The value shown is the highest d/D ratio that was measured during the entire flow monitoring period.

The flow monitoring data suggests that there is a pump station upstream from the flow monitoring site. Given a typical pump station's run time and the flow monitoring data reporting interval of 15 minutes, the instantaneous peak flows discharging the pump station may not have been captured at through the flow monitoring site due to attenuation.

**Table 2. Flow Monitoring Results Summary**

Item	Result
ADWF – Weekday:	6.2 <i>gpm</i>
ADWF – Weekend:	4.6 <i>gpm</i>
ADWF – Overall:	5.8 <i>gpm</i>
Weekend-to-Weekday Ratio:	0.75
Peak Measured Flow:	14.0 <i>gpm</i>
Peaking Factor:	2.4
Peak Flow Depth:	3.3 <i>inches</i>
d/D Ratio:	0.27

**gpm = gallons per minute**

Site 1: Week of Aug 26 to Sep 2 - Level, Velocity and Flow

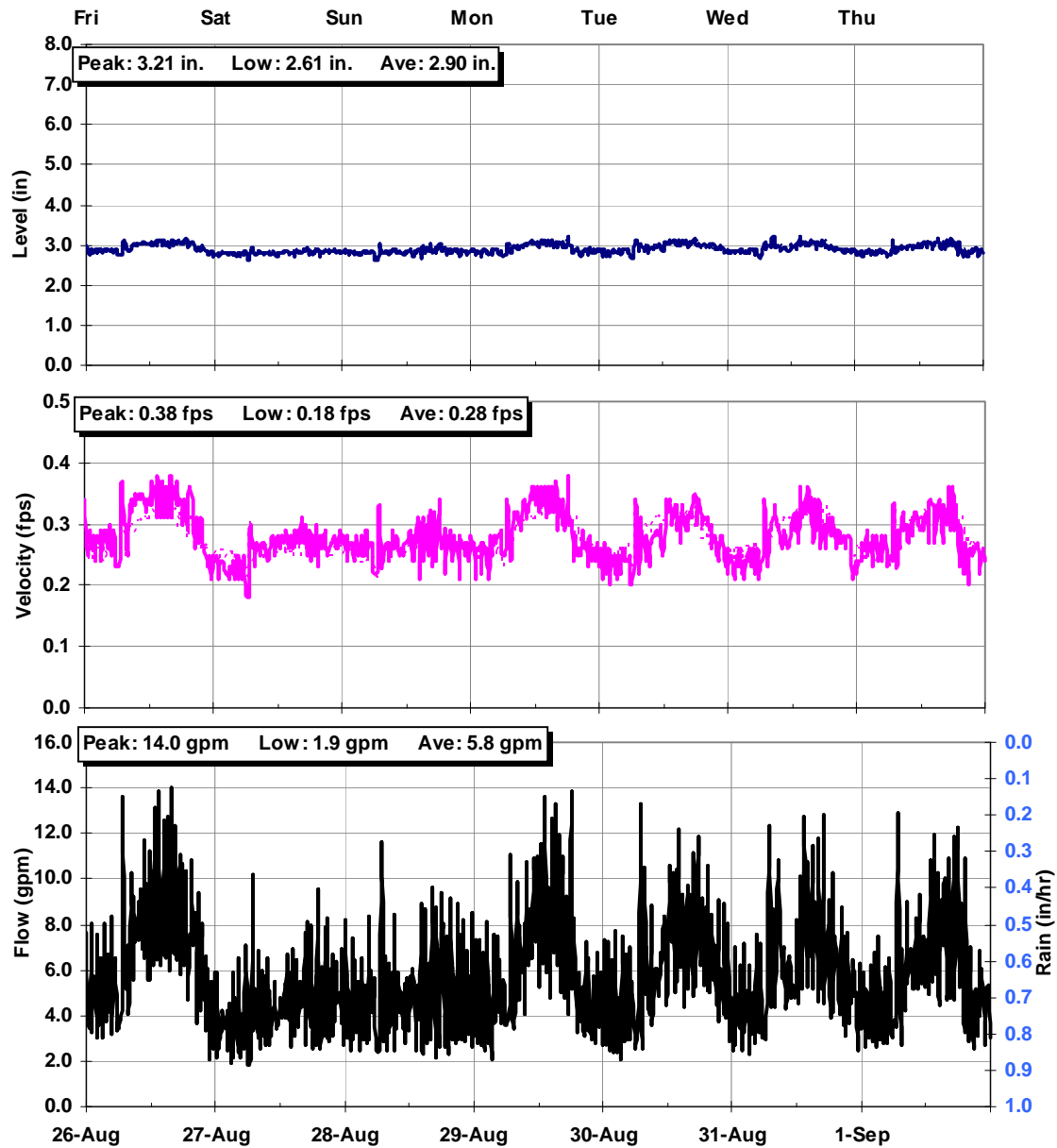


Figure 6. Level, Velocity and Flow Data – August 26 through September 1, 2011



Site 1: Week of Sep 2 to Sep 9 - Level, Velocity and Flow

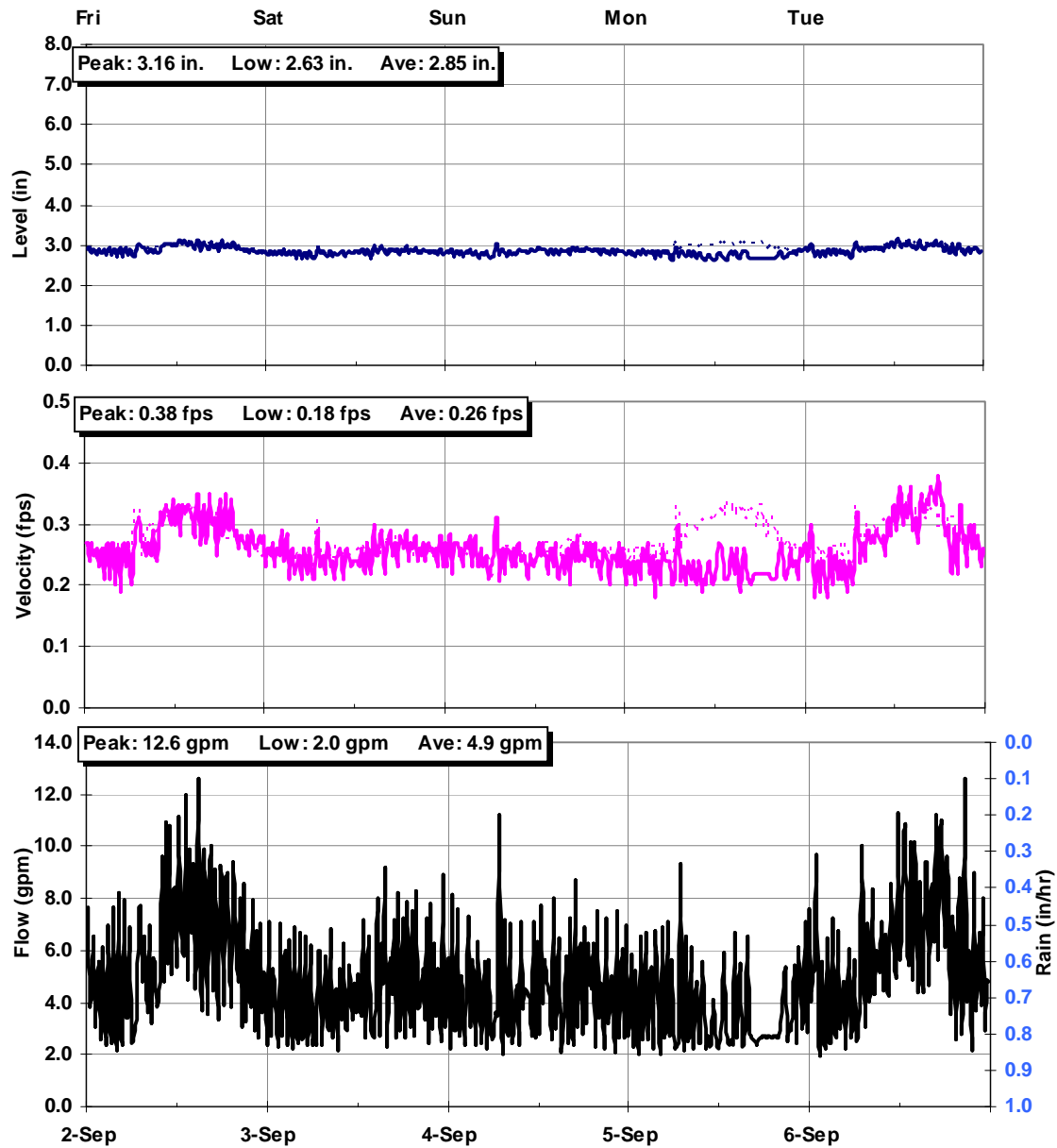


Figure 7. Level, Velocity and Flow Data – September 2 through September 6, 2011

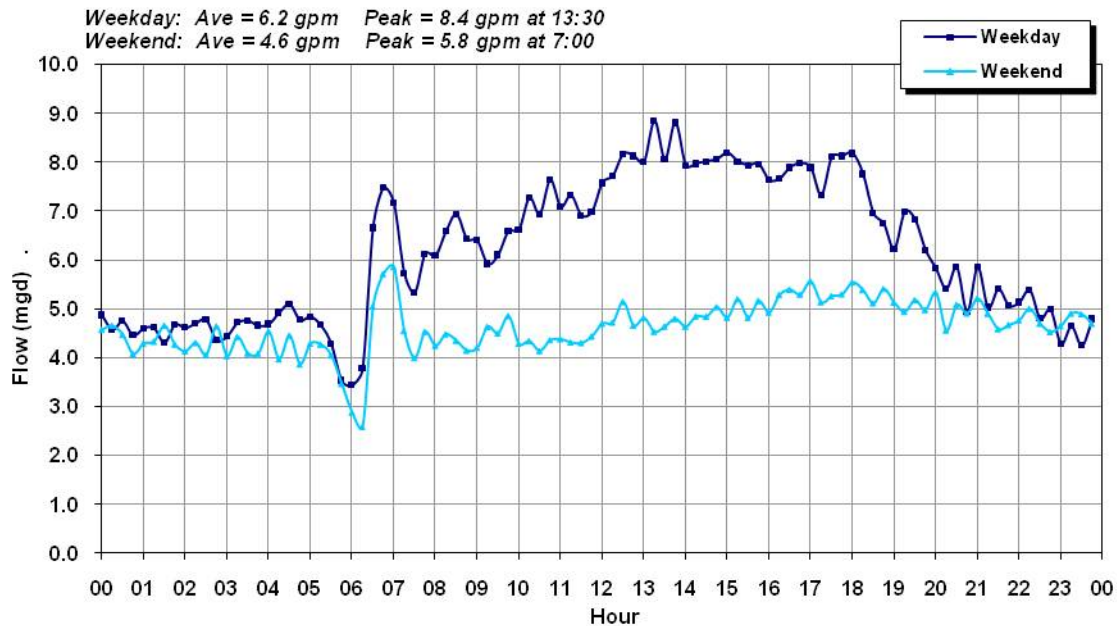


Figure 8. Weekday/Weekend Average Dry Weather Flows

## PIPELINE CAPACITY

The pipeline capacity was estimated by using the Manning formula. The Manning formula estimates the hydraulic properties of flow in an open channel based on the following characteristics of the flow conduit:

$D$  = Diameter of pipe (in.)  
 $d$  = Depth of flow (in.)  
 $S$  = Pipeline slope  
 $n$  = Roughness coefficient

The roughness coefficient is assumed to be  $n = 0.013$  for sanitary sewer pipe. The capacity of the pipeline is calculated during the full-flow condition wherein the depth of flow is equal to the diameter of the pipeline. For this condition, the capacity of the pipeline in gallons per minute (gpm) is estimated as follows:

$$Capacity = \frac{0.8865 \times \frac{\pi}{4} D^2 \times \left(\frac{D}{4}\right)^{\frac{2}{3}} \times Slope^{\frac{1}{2}}}{n}$$

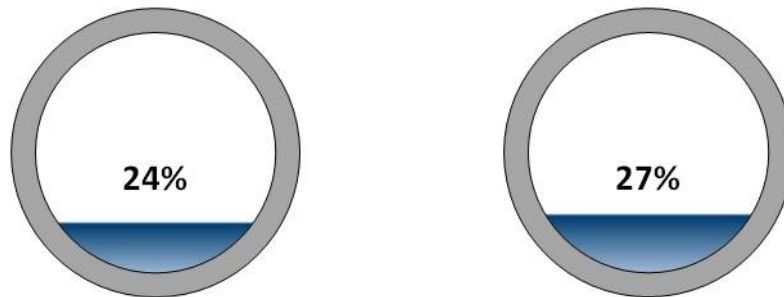
The slope for the flow monitoring site was obtained from drawings provided by BKF and is 0.246%.

Table 3 summarizes the measured flow and estimated capacity data, including the average dry weather flow and peak measured flow.

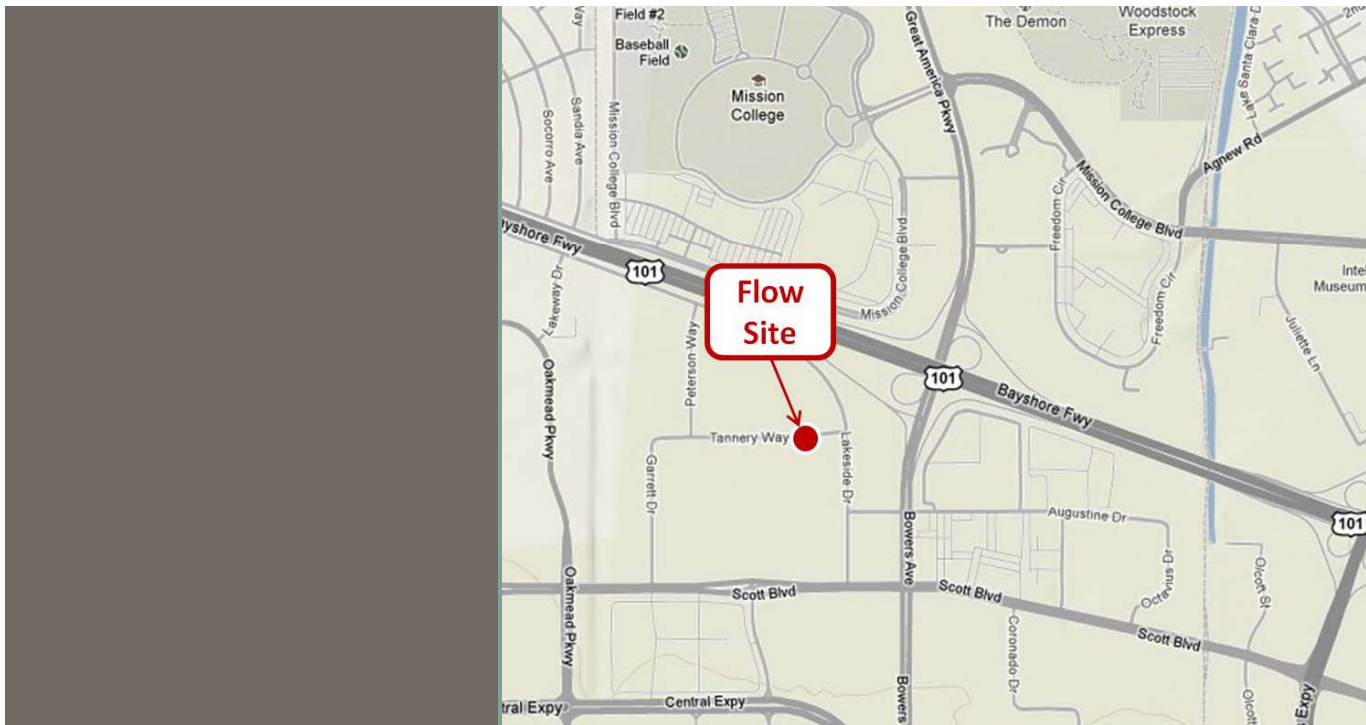
**Table 3. Average Dry Weather Flow and Peak Measured Flow**

Item	Result
Site 1 – Estimated 100% Capacity of Pipeline:	796 gpm
Site 1 – Average Dry Weather Flow:	5.75 gpm
Site 1 – Peak Measured Dry Weather Flow:	13.99 gpm
Site 1 – Available Capacity (Capacity less Peak):	782 gpm

Figure 9 shows average and peak flow cross-sectional view snapshots for the flow monitoring site.



**Figure 9. Average and Peak Flow Cross-Sectional Snapshot Views**



#### **Oakland**

155 Grand Avenue, Suite 700  
Oakland, CA 94612  
510.903.6600 **Tel**  
510.903.6601 **Fax**

#### **San Diego**

8291 Aero Place, Suite 110  
San Diego, CA 92123  
858.576.0226 **Tel**  
858.576.0004 **Fax**

#### **Seattle**

14900 Interurban Avenue, Suite 268  
Seattle, WA 9818  
206.674.4560 **Tel**  
206.674.4561 **Fax**

#### **Houston**

8220 Jones Road, Suite 500  
Houston, TX 77065  
713.840.6490 **Tel**  
713.840.6491 **Fax**

[vaengineering.com](http://vaengineering.com)